ARHITECTURA SISTEMELOR DE CALCUL SEMINAR 0x00

NOTIȚE SUPORT SEMINAR

Cristian Rusu

CONVERSII, EX 1

				0x1111

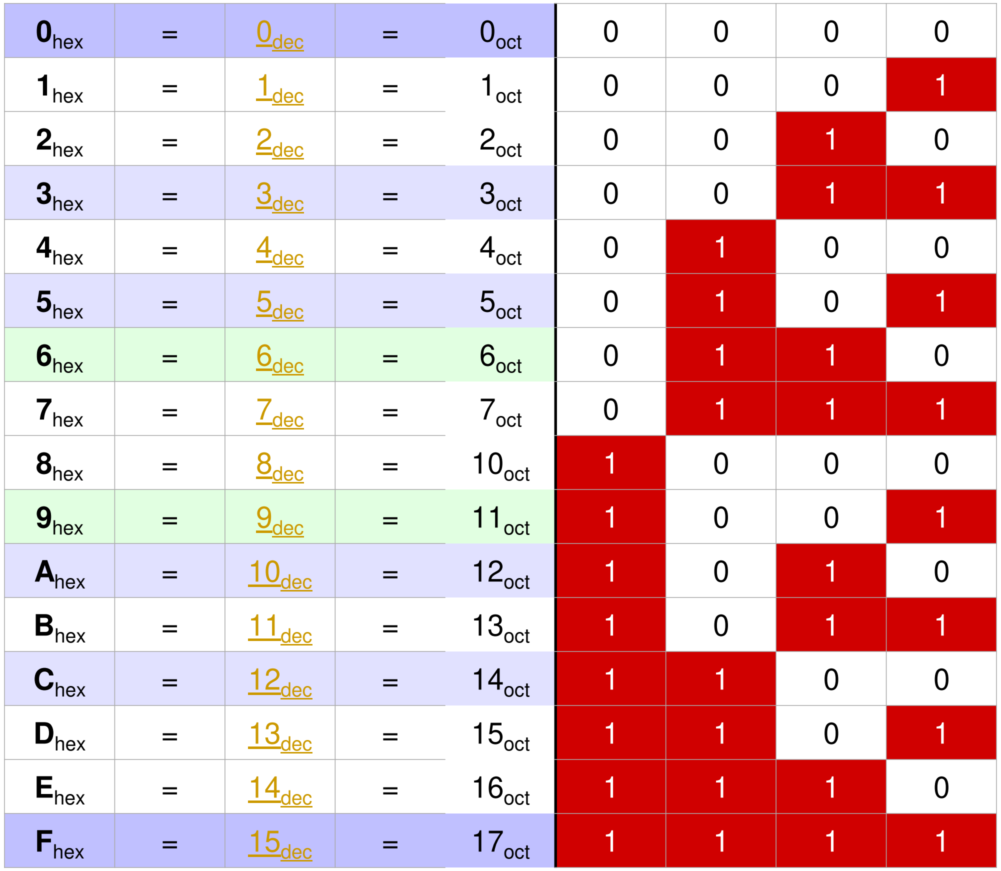
hexa: 0x1111

binar: 0001 0001 0001 0001

baza 4: 00 01 00 01 00 01 00 01 = 01010101

baza 8: 0 001 000 100 010 001 = 10421

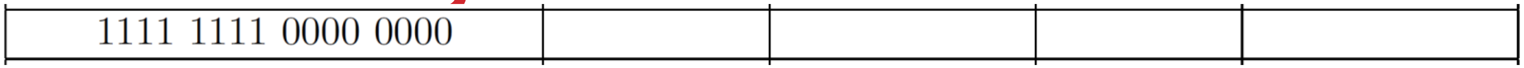
baza 10: 4369



$\mathbf{0}_{\text{hex}}$	=	0_{dec}	=	0_{oct}	0	0	0	0
$\mathbf{1}_{\text{hex}}$	=	1_{dec}	=	1_{oct}	0	0	0	1
$\mathbf{2}_{\text{hex}}$	=	2_{dec}	=	2_{oct}	0	0	1	0
$\mathbf{3}_{\text{hex}}$	=	3_{dec}	=	3_{oct}	0	0	1	1
$\mathbf{4}_{\text{hex}}$	=	4_{dec}	=	4_{oct}	0	1	0	0
$\mathbf{5}_{\text{hex}}$	=	5_{dec}	=	5_{oct}	0	1	0	1
$\mathbf{6}_{\text{hex}}$	=	6_{dec}	=	6_{oct}	0	1	1	0
$\mathbf{7}_{\text{hex}}$	=	7_{dec}	=	7_{oct}	0	1	1	1
$\mathbf{8}_{\text{hex}}$	=	8_{dec}	=	10_{oct}	1	0	0	0
$\mathbf{9}_{\text{hex}}$	=	9_{dec}	=	11_{oct}	1	0	0	1
$\mathbf{A}_{\text{hex}}$	=	10_{dec}	=	12_{oct}	1	0	1	0
$\mathbf{B}_{\text{hex}}$	=	11_{dec}	=	13_{oct}	1	0	1	1
$\mathbf{C}_{\text{hex}}$	=	12_{dec}	=	14_{oct}	1	1	0	0
$\mathbf{D}_{\text{hex}}$	=	13_{dec}	=	15_{oct}	1	1	0	1
$\mathbf{E}_{\text{hex}}$	=	14_{dec}	=	16_{oct}	1	1	1	0
$\mathbf{F}_{\text{hex}}$	=	15_{dec}	=	17_{oct}	1	1	1	1

https://en.wikipedia.org/wiki/Binary_number

CONVERSII, EX 1



1111 1111 0000 0000				

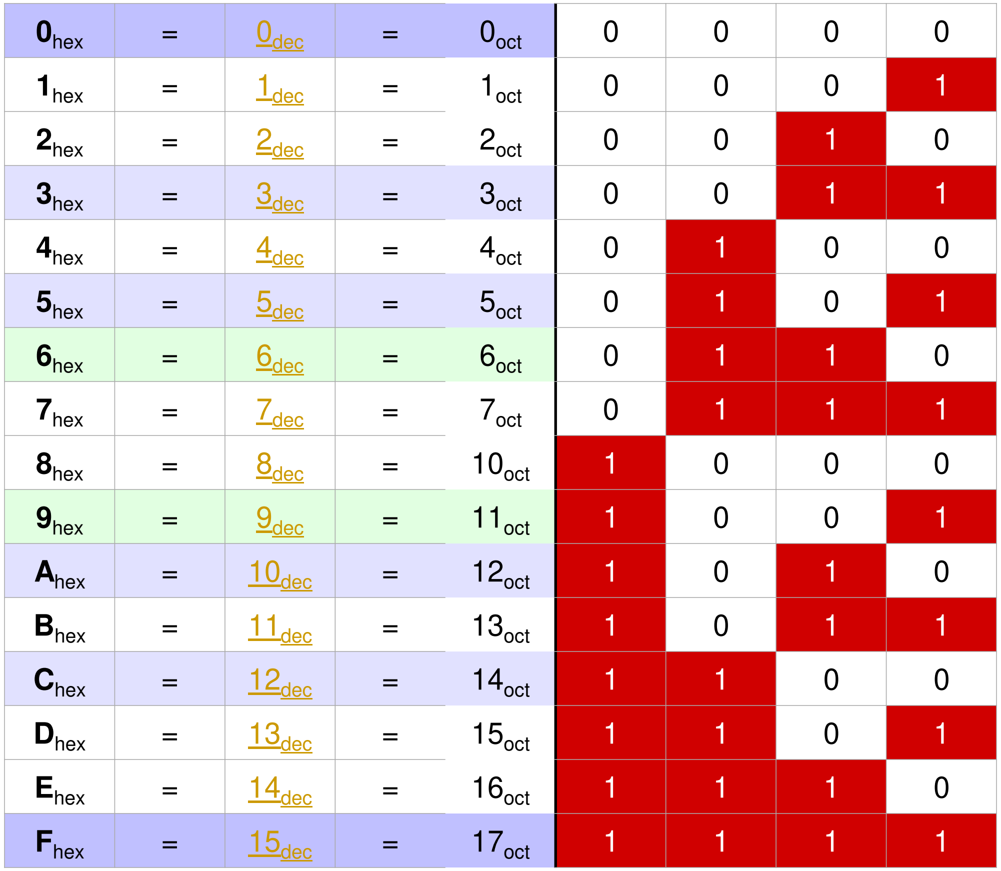
binar: 1111 1111 0000 0000

hexa: 0xFF00

baza 4: 11 11 11 11 00 00 00 00 = 33330000

baza 8: 1 111 111 100 000 000 = 177400

baza 10: 65280



0_{hex}	=	0_{dec}	=	0_{oct}	0	0	0	0
1_{hex}	=	1_{dec}	=	1_{oct}	0	0	0	1
2_{hex}	=	2_{dec}	=	2_{oct}	0	0	1	0
3_{hex}	=	3_{dec}	=	3_{oct}	0	0	1	1
4_{hex}	=	4_{dec}	=	4_{oct}	0	1	0	0
5_{hex}	=	5_{dec}	=	5_{oct}	0	1	0	1
6_{hex}	=	6_{dec}	=	6_{oct}	0	1	1	0
7_{hex}	=	7_{dec}	=	7_{oct}	0	1	1	1
8_{hex}	=	8_{dec}	=	10_{oct}	1	0	0	0
9_{hex}	=	9_{dec}	=	11_{oct}	1	0	0	1
A_{hex}	=	10_{dec}	=	12_{oct}	1	0	1	0
B_{hex}	=	11_{dec}	=	13_{oct}	1	0	1	1
C_{hex}	=	12_{dec}	=	14_{oct}	1	1	0	0
D_{hex}	=	13_{dec}	=	15_{oct}	1	1	0	1
E_{hex}	=	14_{dec}	=	16_{oct}	1	1	1	0
F_{hex}	=	15_{dec}	=	17_{oct}	1	1	1	1

https://en.wikipedia.org/wiki/Binary_number

CONVERSII, EX 2

				0xFEED

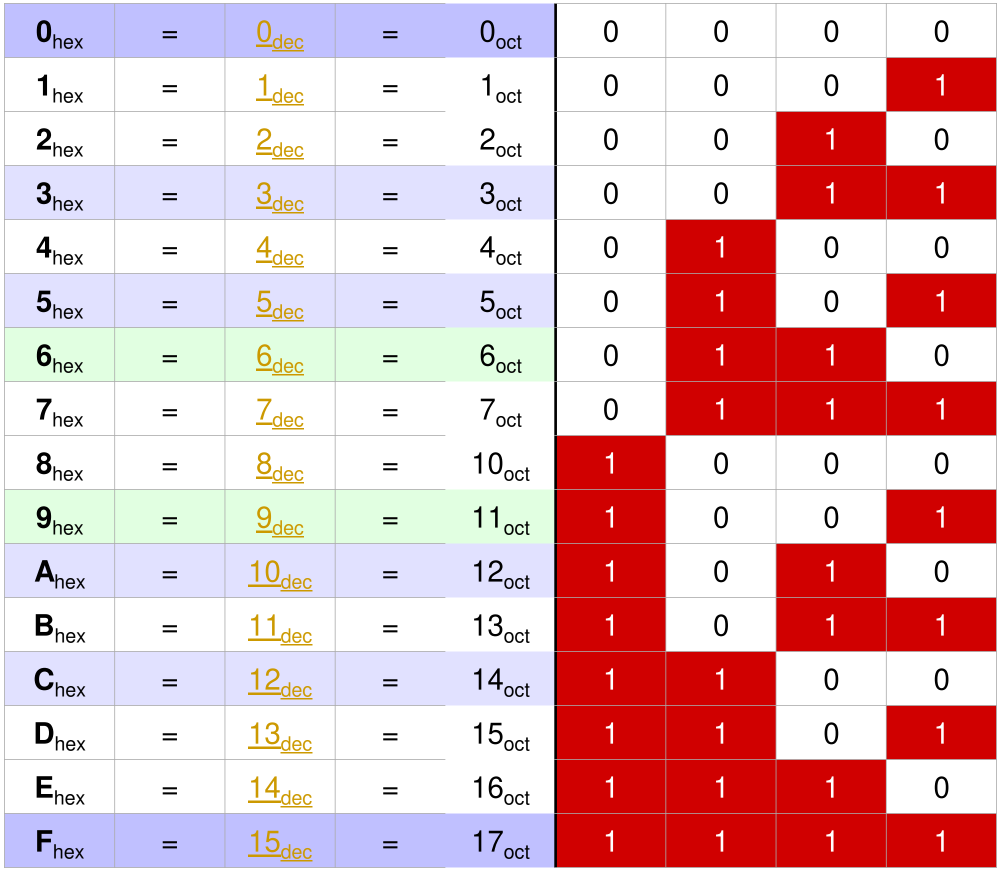
hexa: 0xFEED

binar: 1111 1110 1110 1101

baza 4: 11 11 11 10 11 10 11 01 = 33323231

baza 8: 1 111 111 011 101 101 = 177355

baza 10: -275



0_{hex}	=	0_{dec}	=	0_{oct}	0	0	0	0
1_{hex}	=	1_{dec}	=	1_{oct}	0	0	0	1
2_{hex}	=	2_{dec}	=	2_{oct}	0	0	1	0
3_{hex}	=	3_{dec}	=	3_{oct}	0	0	1	1
4_{hex}	=	4_{dec}	=	4_{oct}	0	1	0	0
5_{hex}	=	5_{dec}	=	5_{oct}	0	1	0	1
6_{hex}	=	6_{dec}	=	6_{oct}	0	1	1	0
7_{hex}	=	7_{dec}	=	7_{oct}	0	1	1	1
8_{hex}	=	8_{dec}	=	10_{oct}	1	0	0	0
9_{hex}	=	9_{dec}	=	11_{oct}	1	0	0	1
A_{hex}	=	10_{dec}	=	12_{oct}	1	0	1	0
B_{hex}	=	11_{dec}	=	13_{oct}	1	0	1	1
C_{hex}	=	12_{dec}	=	14_{oct}	1	1	0	0
D_{hex}	=	13_{dec}	=	15_{oct}	1	1	0	1
E_{hex}	=	14_{dec}	=	16_{oct}	1	1	1	0
F_{hex}	=	15_{dec}	=	17_{oct}	1	1	1	1

https://en.wikipedia.org/wiki/Binary_number

CONVERSII, EX 2

1111 1111 0000 0000				

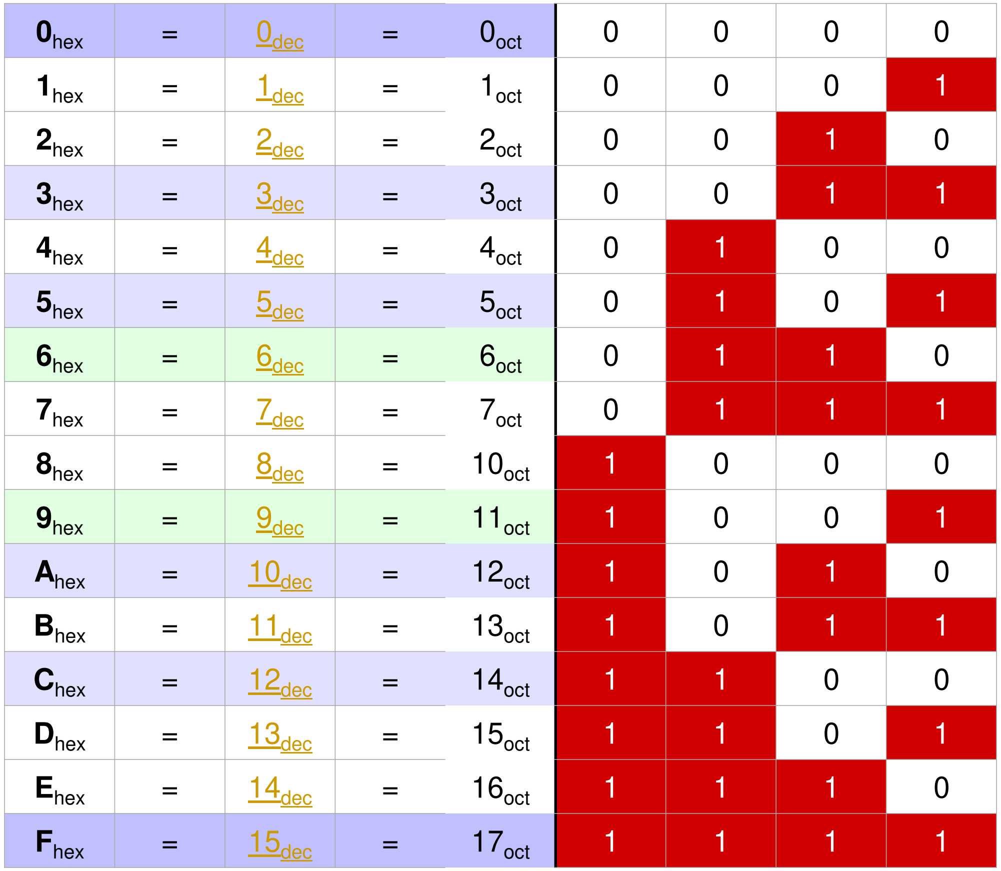
binar: 1111 1111 0000 0000

hexa: 0xFF00

baza 4: 11 11 11 11 00 00 00 00 = 33330000

baza 8: 1 111 111 100 000 000 = 177400

baza 10: -256



0_{hex}	=	0_{dec}	=	0_{oct}	0	0	0	0
1_{hex}	=	1_{dec}	=	1_{oct}	0	0	0	1
2_{hex}	=	2_{dec}	=	2_{oct}	0	0	1	0
3_{hex}	=	3_{dec}	=	3_{oct}	0	0	1	1
4_{hex}	=	4_{dec}	=	4_{oct}	0	1	0	0
5_{hex}	=	5_{dec}	=	5_{oct}	0	1	0	1
6_{hex}	=	6_{dec}	=	6_{oct}	0	1	1	0
7_{hex}	=	7_{dec}	=	7_{oct}	0	1	1	1
8_{hex}	=	8_{dec}	=	10_{oct}	1	0	0	0
9_{hex}	=	9_{dec}	=	11_{oct}	1	0	0	1
A_{hex}	=	10_{dec}	=	12_{oct}	1	0	1	0
B_{hex}	=	11_{dec}	=	13_{oct}	1	0	1	1
C_{hex}	=	12_{dec}	=	14_{oct}	1	1	0	0
D_{hex}	=	13_{dec}	=	15_{oct}	1	1	0	1
E_{hex}	=	14_{dec}	=	16_{oct}	1	1	1	0
F_{hex}	=	15_{dec}	=	17_{oct}	1	1	1	1

https://en.wikipedia.org/wiki/Binary_number

OPERAȚII BINARE, EX 3

$$\begin{array}{r|l} 0101\ 1100\ 1111\ 0011 & \\ 1111\ 1111\ 0000\ 0000 & + \\ \hline 0101\ 1011\ 1111\ 0011 & \end{array}$$

$$\begin{array}{r|l} 1111\ 1111\ 1111\ 1111 & \\ 0000\ 0000\ 0000\ 0001 & + \\ \hline & \end{array}$$

- **care sunt operanzii/rezultatul (zecimal/binar)?**
  - stânga: 23795 și -256, rezultatul 23539
  - dreapta: -1 și +1

OPERAȚII BINARE, EX 3

$$\begin{array}{r|l} 1111\ 1111\ 1111\ 1111 & \\ 1000\ 0000\ 0000\ 0000 & + \\ \hline & \end{array} \qquad \begin{array}{r|l} 1000\ 0000\ 0000\ 0000 & \\ 0000\ 0000\ 0000\ 0001 & + \\ \hline & \end{array}$$

- **care sunt operanzii/rezultatul (zecimal/binar)?**
  - stânga: -1 și -32 768
  - dreapta: -32 768 și +1

OPERAȚII BINARE, EX 4

$$\begin{array}{c|l} 0101\ 1100\ 1111\ 0011 & \\ 0101\ 1100\ 1111\ 0011 & \text{AND} \\ \hline & \end{array}$$

X	Y	X AND Y
0	0	0
0	1	0
1	0	0
1	1	1

$$\begin{array}{c|l} 1101\ 1100\ 1111\ 0011 & \\ 1101\ 1100\ 1111\ 0011 & \text{XOR} \\ \hline & \end{array}$$

X	Y	X XOR Y
0	0	0
0	1	1
1	0	1
1	1	0

OPERAȚII BINARE, EX 4

0000 0000 1111 1111	
0000 0001 0000 0000	AND

1100 0110 1001 1110	
1001 1111 0110 1100	XOR
1100 0110 1001 1110	XOR

X	Y	X AND Y
0	0	0
0	1	0
1	0	0
1	1	1

X	Y	X XOR Y
0	0	0
0	1	1
1	0	1
1	1	0

ÎNTREBĂRI SCURTE, EX 5

a) $2^N - 1$

b) $2^{N-1} - 1$ și -2^{N-1}

c) aproximativ $\log_2 x$, exact sunt $\mathrm{ceil}(\log_2 (x+1))$

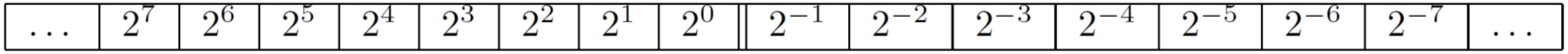
d) 4k

e) ceil (k / 4)

f) ceil ($k \log_2 10$)

ceil() rotunjește mereu în sus

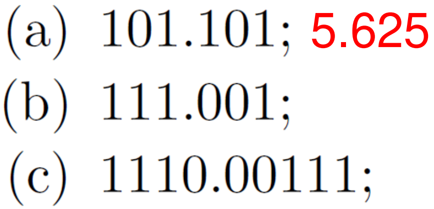
BINARY FIXED-POINT, EX 6



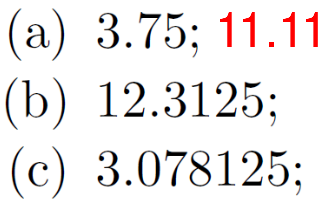
...	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	...

- ½ = 0.5
- ¼ = 0.25
- 1/8 = 0.125
- 1/16 = 0.0625
- ...

- Calculați reprezentările pentru



(a) 101.101; 5.625
(b) 111.001;
(c) 1110.00111;



(a) 3.75; 11.11
(b) 12.3125;
(c) 3.078125;

COMPLEMENT FAȚĂ DE DOI, EX 7

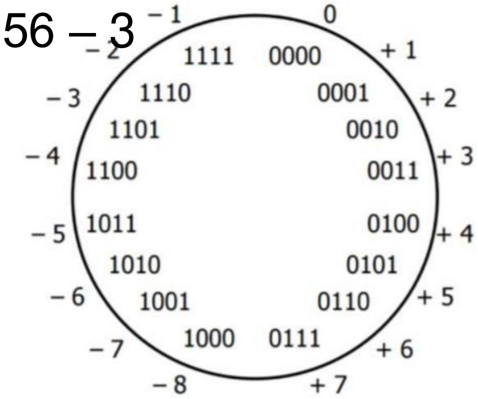
bit b_i:	1	1	1	1	0	0	0	1
2^i:	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

- $x = -b_{N-1}2^{N-1} + \sum_{i=0}^{N-2} b_i 2^i$

- **ca să reprezentăm un număr negativ, luăm valoarea pozitivă a numărului, îi inversăm biții și adunăm unu**
- **de ce funcționează această procedură?**
  - pornim de la faptul că folosim aritmetică modulo
  - fixăm și suntem pe 8 biți
  - deci, să scădem 3 e echivalent cu a aduna 256 – 3
  - -3 ≡ 256 – 3 = 1 0000 0000 – 0000 0011

    = 1 + 1111 1111 – 0000 0011

    = 1 + (3 cu biții inversați)



COMPLEMENT FAȚĂ DE DOI, EX 7

bit b_i:	1	1	1	1	0	0	0	1
2^i:	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

- $x = -b_{N-1}2^{N-1} + \sum_{i=0}^{N-2} b_i 2^i$

- **ca să reprezentăm un număr negativ, luăm valoarea pozitivă a numărului, îi inversăm biții și adunăm unu**
- **de ce funcționează această procedură?**

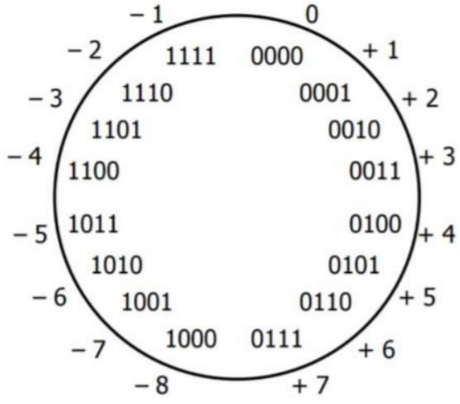
$$-\left(-2^N + \sum_{i=0}^{N-1} b_i 2^i\right) = 2^N - \sum_{i=0}^{N-1} b_i 2^i$$

$$2^{N+1} = \sum_{i=0}^{N} 2^i + 1$$

$$= \sum_{i=0}^{N-1} 2^i + 1 - \sum_{i=0}^{N-1} b_i 2^i$$

$$= \sum_{i=0}^{N-1} (1 - b_i) 2^i + 1$$

$$= (\text{inversam bitii}) + 1$$



LOGARITM ÎNTREG, EX 9

bit b_i:	0	1	1	1	0	0	0	1
2^i:	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

- **arătați că** $\lfloor \log_2 x \rfloor = i_{\max}$
- **pornim de la reprezentarea binară și aplicăm logaritmul**

$$x = \sum_{i=0}^{N-1} b_i 2^i$$

$$\begin{aligned}
\log_2 x = & \log_2 \left(\sum_{i=0}^{N-1} b_i 2^i \right) \\
= & \log_2 \left(2^{i_{\max}} \left(\sum_{i=0}^{N-1} b_i \frac{2^i}{2^{i_{\max}}} \right) \right) \\
= & \log_2 2^{i_{\max}} + \log_2 \left(\left(\sum_{i=0}^{N-1} b_i \frac{2^i}{2^{i_{\max}}} \right) \right) \\
= & i_{\max} + C, \;\; C < 1
\end{aligned}$$